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Cost Of Study Reinforced Concrete Structures, Structural Steel And Steel Combination Structure - Concrete
(Depo Archives Building Case Study District Jepara)

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Abstract **-** Office buildings in its development always use a reinforced concrete structure. Very few and rarely encountered office buildings using steel structures, whereas steel structures are very easy and fast to use with very simple tool installation tools, so it saves procurement costs and time. For that reason it is necessary to review the material used in the determination of the cheap cost in a design of the building structure, in this study take case study of Depo Archive Building of Jepara Regency with level three (3) floor, the part of structure that is reviewed is column, platform. This study uses design design method and unit price analysis method based on Indonesian National Standard (SNI). The design results calculated with SAP 2000 if it is stated strong, then proceed into the calculation of costs. The results of these cost calculations are compared with six combinations of structures using different materials ie Type I (concrete columns, concrete blocks and concrete plates), Type II (concrete columns, concrete blocks and plates using bonded), Type III (concrete columns, steel and concrete plate), Type IV (concrete columns, steel beams and plate using bonded), Type V (steel columns, steel beams and concrete plates), Type VI (steel columns, steel beams and plate using bonded), where the cost the cheapest is on the Type IV structure at a cost of Rp. 851,922,778.91 and the most expensive cost on Type V structures at a cost of Rp. 1,724,793,719.48.

Keywords**:** *material, cost, structure concrete, structure steel, plate floor*.

1. Preliminary

Construction of buildings graded very fast its development especially building offices Where in its development always use structure concrete reinforced. Very a little and rarely encountered building offices use structure steel, whereas structure steel very easy and fast its use with tool help means the installation of a very simple, so very save cost procurement and time.

According to Wildiyanto (2008) says cost implementation work column beam structure concrete more cost 34% less than the use structure steel on Comparison Structure Concrete Again with Steel structure of Element Beam Column Judging Of Aspects Cost In the Housing Development Shop 3rd Floor.

Use structure steel as replacement structure concrete boned for column and beam on building the if based on ϕ Mn and ϕ Pn with dimension from design structure concrete more mahal from structure steel according to Futariani (2013) on Study As Steel Structures Alternative Structural Design Review Concrete Reinforced (Study Case On Building LPTK FT UNY).

According to study analysis cost by Widhiawati (2010) on a conventional plate and using a metal deck plate shows that the conventional plate more expensive than the deck with a metal plate difference cost of 7.51%, while according to Saragih (2016) also say

that concrete slab work bonded more efficient instead of concrete slab conventional on Analysis Comparison Cost Plate Concrete Bondek And Plates Concrete Conventional On Construction Building Multilevel (Study Case: office Uluwatu Square), but according to study Test (2015) said that costimplementation workers a n plate floor boundeck more expensive compared with plate concrete conventional.

According to Alma'mun (2016) on Analysis Comparison Cost Steel structure with Structure Concrete Again On Project Building Home Sick Provins V.L Ratumbuysang Manado produce analysis calculation cost for structure concrete boned found price amount Rp. 4,376,770,543.81. while cost for structure steel held in the project price amount Rp 6,239,227,404.84 with so structure steel more expensive of the structure concrete.

The problem to be known is how much the cost of planning and cost differences between types that is when executed with the following materials:

1) Concrete Column, Concrete Beam and Concrete Platform
2) Column Concrete, Concrete Beam and Plate Bondek
3) Column Concrete, Steel Beam and Concrete Platform
4) Column Concrete, Steel Beam and Bondek Plate
5) Steel Column, Steel Beam and Concrete Platform
6) Steel Column, Steel Beam and Bondek Plate

2. Theoretical Basis

2.1. Analysis Cost

Before sign in to in analysis costs, there some study related fees to be understood more first, one only is concept costs. Asiyanto in his book Construction Cost Management mentionThere are two (2) groups big in component costs, namely cost (direct costs) and cost no direct (indirect costs).

2.1.1. Cost directly

Referred with cost directly here is whole costs associated with the activities carried out in the project (from preparation to settlement) and bring in whole source power required by projectThe. Cost directly this too ordinary called with cost no fixed (variable cost), because character his each month no permanent or changeable corresponding with progress jobs. By linelarge, charge directly on project construction corresponding with the above definition divided into five, namely:

a. Cost / material
b. Cost wage labor (labor)
c. Cost tool
d. Cost subcontractor
e. Other expenses

Other costs are usually relatively small, but when the amount enough means for controlled could specified, be for example:

a. Cost preparation and completion
b. Cost preparation and completion
c. Project overhead costs and so on

For necessities budgeting and controlling, each cost aforementioned given code according to type, ie materials, wages, tools, subcontractors, and others. As for example for cost materials, detailed again be cement, stone, sand, iron concrete, wood, paint, and so forth. For cost wage work too specified corresponding type work, like cost wage excavation

ground, plug stoneplaster, formwork, reinforcement, cast concrete, and so forth. So too for cost tool. in report finance, usually presented enough to post materials, wages, tools, and subcontractor no needspecified again, but for necessities controls, costs the could grouped to each kind.

2.1.2. Cost No Directly

Referred with cost no directly here is whole cost on no directly charged to project usually occur outside project. Cost this covers among other charges marketing, overhead costs in office /branch office (not overhead office project). Cost this each month magnitude relatively permanent compared cost directly or called with cost fixed (fixed costs). By because that incalculate cost project, plus with load cost permanent company (incorporated in mark up project). Usually load cost permanent this inserted in prosentase from cost directly project,although cost this its nature still, should do control, so as not past budget. Following is a concept diagram cost based on Asiyanto: 2005

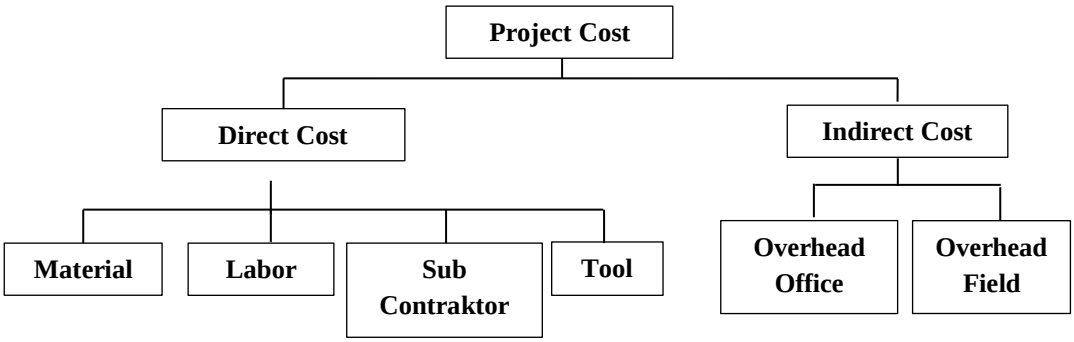

Figure 1. Cost Concept Diagram
Source: Asiyanto: 2005

2.2. Structure Concrete

In construction , concrete is a ingredients building composite made from combination aggregate and fastener cement . The most common form from concrete is Portland cement concrete, which comprises from mineral aggregate (usually gravel and sand), cement and water .

Usually trusted that concrete dry up after mixing and laying. Actually, concrete no be solid for water yawn , but cement hydratious , gluing component others together and finally forming materials such as stone. Concrete used for make pavement street, structure building, p ondasi, roads, bridges crossing, structure parking, basic for fence / gate, and cement brick or Wall block. The old name for concrete is stone liquid.

According to SNI 03-2847 - 2002 concrete is material obtained with portland cement mixing or other hydraulic cement, aggregate smooth, aggregate rude and water, with or without ingredients additional form time solid.

2.3. Steel Structures

Steel is ingredients with character structure well, have high strength and same strong on power Pull as well press. Steel is element structures that have limits perfect will hold back load type Pull axial, press axial, and supple with facilities were almost same.

2.4. Loading

The combination and load factors used in this planning review refer to the Indonesian Building Regulatory Standards, SNI-1727-1989 F, which are:

1) Strong U need to hold dead load D at least equal to:

U = 1,4 D ..... (1)

2) Strong U need to withstand dead load D, live load L and also roof A load or rain load R, that is:

U = 1,2 D + 1,6 L + 0,5 (A atau R) ..... (2)

3) Strong U need taken in taking into account the planning of the structure resistance to earth quake load are:

U = 1,2 D + 1,0 L ± 1,0 E ..... (3)
or
U = 0,9 D ± 1,0 E ..... (4)

Where :
D = Dead load
L = live load
E = Earthquake load
A = Roof load

3. Research Methodology

3.1. Design Method

The design is using SAP 2000 calculation to determine the strength of the building to be designed.

3.2. Unit Price Analysis Method

Analyze the unit price of work using the analysis of unit price of work based on Indonesian National Standard (SNI) and list price of unit of building materials, wages of workers.

4. Discussion

4.1. Styles on Building Structures

In table 1. Finally produces the maximum force that is in type V and type VI, then the minimum force is in type III and type IV.

Table 1. List of Comparison of Forms in Type I to Type VI

Type	M (KN-m)	D (KN)	N (KN)
I	-45,6196	-22,531	-1.189,249
II	47,2220	-23,491	-1.198,753
III	43,2546	-21,183	-792,897
IV	43,7865	-21,416	-800,381
V	-48,8951	24,107	-768,493
VI	-49,5047	24,379	-775,940

4.2. Results of Building Structure Design

In table 2, there is no difference in reinforcement or cross-sectional dimension in each type of structure.

Table 2. Design of Reinforced Concrete Beam

No.	Information	Type	
		I	II
1.	**Beam Size**	**B 350 x 700**	**B 350 x 700**
	reinforcement	15 D 19	15 D 19
	Torsi	4 D 12	4 D 12
	Dash - Focus - field	 D10 – 100 D10 - 200	 D10 – 100 D10 - 200
2.	**Beam Size**	**B 300 x 600**	**B 300 x 600**
	reinforcement	14 D 19	14 D 19
	Torsi	2 D 12	2 D 12
	Dash - Focus - field	 D10 – 100 D10 - 200	 D10 – 100 D10 - 200
3.	**Beam Size**	**B 250 x 500**	**B 250 x 500**
	reinforcement	9 D 16	9 D 16
	Torsi	-	-
	Dash - Focus - field	 D10 – 100 D10 - 200	 D10 – 100 D10 - 200
4.	**Beam Size**	**B 200 x 300**	**B 200 x 300**
	reinforcement	5 D 16	5 D 16
	Torsi	-	-
	Dash - Focus - field	 D10 – 100 D10 - 200	 D10 – 100 D10 - 200
5.	**Beam Size**	**BA 350 x 650**	**BA 350 x 650**
	reinforcement	13 D 19	13 D 19
	Torsi	-	-
	Dash - Focus - field	 D10 – 100 D10 - 200	 D10 – 100 D10 - 200
6.	**Beam Size**	**BA 200 x 400**	**BA 200 x 400**
	Tulangan	5 D 16	5 D 16
	Torsi	-	-
	Dash - Focus - field	 D10 – 100 D10 - 200	 D10 – 100 D10 - 200

In Table 3, the design of reinforced concrete columns in type I dimensions and reinforcement is the same as type II, while the type III dimensions and reinforcement are the same as the type IV.

Table 3. Design of Reinforced Concrete Columns

No.	Information	Type	
		I , II	III , IV
1.	**Column size**	**K 500x500**	**K 400x400**
	Reinforcement	24 D 16	16 D 16
	Dash	D10 - 150	D8 - 150
2.	**Column size**	**K 300x 300**	**K 250x250**
	Reinforcement	12 D 12	12 D 16
	Dash	D10 - 150	D8 - 150

No.	Information	Type	
		I , II	III , IV
3.	**Column size**	**K 150x150**	**K 200x200**
	Reinforcement	4 D 12	4 D 12
	Dash	D8 - 150	D8 - 150

In Table 4, produces steel columns of the same dimensions on the Type V structure and type VI structure.

Table 4. Results of Steel Field Design

No.	Type V	Type VI
1.	K 400x400x16x24	K 400x400x16x24
2.	K 350x350x14x22	K 350x350x14x22
3.	K 200x200x10x16	K 200x200x10x16

In table 5, it produces the same dimensions of beam size in type III, type IV, type V and type VI structures

Table 5. Design Results of Steel Beam

No.	Type III	Type IV	Type V	Type VI
1.	IWF 450x200x8x12	IWF 450x200x8x12	IWF 450x200x8x12	IWF 450x200x8x12
2.	IWF 400x200x8x13	IWF 400x200x8x13	IWF 400x200x8x13	IWF 400x200x8x13
3.	IWF 350x175x7x11	IWF 350x175x7x11	IWF 350x175x7x11	IWF 350x175x7x11
4.	IWF 300x200x9x14	IWF 300x200x9x14	IWF 300x200x9x14	IWF 300x200x9x14
5.	IWF 250x175x7x11	IWF 250x175x7x11	IWF 250x175x7x11	IWF 250x175x7x11

4.3. Implementation Fee

Implementation costs need to be budgeted or planned, in order to know how much the cost will be implemented. In table 6, the largest beam cost is in type III and IV, while the largest column cost is in type V and VI, because the cost of type III and IV columns and the cost of type V and VI blocks use steel, so that the cost is expensive. And for the cheapest cost in the columns and beams there are in types I and II because it uses reinforced concrete. And for the cheapest cost floor plate on type II, IV and VI because it uses bonded plate. And for the cost of the most expensive floor plate is on type I, III and V because it uses reinforced concrete. If a combination of materials is done, then the most costly structure is in type IV because the column structure uses reinforced concrete, beams using steel and floor plate using bondek. While costly combinations are available on type V, because the columns use steel, the beam uses steel and floor plate using reinforced concrete.

Table 6. Cost Calculation Results in Type I to Type VI

No.	Tipe	Biaya (Rupiah)			Total (Rp)
		Balok	Kolom	Plat Lantai	
1	2	3	4	5	6
1	Tipe I	370.819.909,80	296.018.443,31	313.351.092,27	980.189.445,38
2	Tipe II	370.819.909,80	296.018.443,31	220.091.347,32	886.929.700,43
3	Tipe III	418.347.537,41	213.483.894,19	313.351.092,27	945.182.523,87
4	Tipe IV	418.347.537,41	213.483.894,19	220.091.347,32	851.922.778,91
5	Tipe V	393.609.176,30	1.017.833.450,91	313.351.092,27	1.724.793.719,48

No.	Tipe	Biaya (Rupiah)			Total (Rp)
		Balok	Kolom	Plat Lantai	
1	2	3	4	5	6
6	Tipe VI	393.609.176,30	1.017.833.450,91	220.091.347,32	1.631.533.974,52

5. Conclusions And Recommendations

5.1. Conclutions

From the calculation of the cost of implementation in the above discussion then the authors concluded that with material data as follows:

Material data used:

- The quality of concrete used columns and beams is K 300 with *f'c* = 26.4 MPa
- The modulus of elasticity of concrete (*Ec*) = 24.149,037 Mpa
- Modulus elastisitas steel (*Es*) = 200.000 MPa
- Iron Quality Reinforcement:
  a) Plain reinforcing steel (BJTP-24) for D≤12 mm, *fy* = 240 MPa
  b) Threaded bore steel (BJTD-40) for D≥12 mm, *fy* = 400 MPa
- Specific weight of concrete = 2400 kg / m3
- Specific weight of steel = 7850 kg / m3
- Weight of bondage = 10.1 kg / m2

With the material data above generates a cheap construction cost is in type IV at a cost of Rp. 851,922,778.91 and the most expensive construction cost is in type V at a cost of Rp. 1,724,793,719.48.

5.2. Recommendations

The things that still need to be considered in comparing the cost of performing the work of concrete structures and steel structures are :

1. Need the accuracy in the design and planning to get a nominal low price.
2. The combination of concrete columns, steel beams and plate with bonds is an alternative for planners and contractors in the cost-effectiveness and does not reduce the strength of the structure.

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